AMRAD NEWSLETTER

Amateur Radio Research and Development Corporation June 1981

OUR JUNE 1 MEETING will give you the chance to meet our 1981 high school science fair winners and learn about their projects. AMRAD makes annual awards to students who have shown excellence in science projects, particularly in electronics. The meeting will be from 7:30 to 9:00 p.m. at the Patrick Henry Branch Library, 101 Maple Ave E, Vienna, VA. Please bring your families.

John Kanode, N4MM, Vice Director, American Radio Relay League Roanoke Division, will make brief remarks.

The AMRAD Award conveys AMRAD membership and a subscription to an amateur radio or personal computing magazine of their choice. Award winners are:

Marc A. Friedman
Christopher M. Hutchinson
Christopher D. Payne
Andrew W. Pckholtz
Kenneth Alan Wheeler
Ivan Yourshaw

Award winners have been invited to present short talks at the meeting.

Honorable Mention was given to the following students:

Robert J. Adams
Douglas W. Anderson
Tanara L. Cohen
Stephen Robert Garland
Scott E. Kelso
Scott D. Kier & R. Chris Maslyn
Colleen Amelia Lingley
James B. Marshall
Edwin P. Miller
Michael B. Moore
Bryan Stuart Morse
Amir Masoud Pirnazar
Cheng Tang
Steven B. Waltman
David R. Wolf
Albert S. Yen

Congratulations to all these students for a job well done.

Bill Pala, our science fair program chairman, wishes to thank Terry Fox, George Lemaster, John Miller, Elton and Nan Sanders, who served as judges this year.

HISTORY WAS MADE IN MAY on both packet radio and spread spectrum fronts.

On May 4, Bill Moran, W4MIB of Vienna, VA became the first in this area to transmit packets. Bill transmitted HDLC packets at 1200 baud using a Bell 202 modem over the AMRAD repeater on 147.81/.21. For more on this topic see Dave Borden's Protocol column.

May 5 marked the day of the first two-way amateur spread spectrum contact between Dick Kessler, K2SZE in Rochester, NY and Paul Rinaldo, W4RI in McLean, VA. A number of contacts have been made on 40 and 20 meters. using frequency hopping. See Hal Feinstein's Spread Spectrum column premiering in this issue.

AN AMATEUR RADIO COMPUTER NETWORKING conference, sponsored by the ARRL, will be held on October 16, 1981 at the National Bureau of Standards, Gaithersburg, MD. It will be hosted by AMRAD and AMSAT and falls on the day before AMSAT's annual meeting at the nearby Goddard Space Flight Center. Those wishing to present papers should send a letter of intent before August 15 to Paul L. Rinaldo, W4RI, 1524 Springvale Ave, McLean, VA 22101.

THE ROANOKE DIVISION LPM'81 on May 9-10 went very well despite lower-than-hoped-for attendance from some parts of the division. Offsetting that was good representation from the FCC. AMRAD received a number of compliments on the technical program which covered AMSAT, packet radio and radio amateur technical achievements (paper is in this issue of the newsletter). We would like to thank Dr. Michael J. Marcus of the FCC Office of Science and Technology for moderating the session, also Dr. Thomas Clark, W3IWI, president of AMSAT for speaking on the amateur satellite program. Dave Borden, K8MMO gave an introductory talk on packet radio and gave the audience a glimpse of where amateur computer networking is headed in the next few years.

Random Musings over a Couple of Disemboweled 33's

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Through the generosity of the Bell System and others, there may be an enormous quantity of Model 33 and Model 35 TTY's available to the deaf at little or no cost. The question is: "Is it feasible to equip these machines with the necessary code-conversion and modem hardware for use in the Baudot-oriented TDD network for the deaf, or would it be better to politely thank Telco and consign them to the crusher?"

ARGUMENTS FOR ADAPTING 33's AND 35's:

1) The initial cost is negligible or zero.

2) The machines produce hard copy. Some people have great difficulty using moving-text single-line displays.

3) Low-error-rate paper tape machines are plentiful, saving long-distance charges and tape-recorder hassles.

4) The machines are inherently ASCII and have a much larger character set, lending them to other applications such as Computer-Assisted Instruction (CAI) and programming.

ARGUMENTS FOR AVOIDING 33's AND 35's:

1) The machines are mechanically complex and difficult to service.

2) The machines are bulky and heavy.

3) The bewildering selection of all-control units and modifications requires a good selection of schematics and considerable skill for interfacing them.

4) The units run at 110 baud. Nowadays, virtually all low-speed terminals run at 300 baud, so the "dual use" as a computer terminal is severely limited.

The baud rate limitation mentioned above may turn out to be the most serious deterrent. Many time-sharing services no longer offer 110-baud dial-in ports.

However, let's consider a compromise approach. Suppose we take a single-chip microcomputer, such as the Motorola 6801, which has some internal RAM, some parallel I/O ports and a timer. The timer, if it has a free-run mode, should be able to be programmed to generate the 1400/1800-Hz modem tones and to demodulate the received signals on a pulse-counting basis. Given some type of moderately slow (say 1-10 kHz) timing source (such as the processor clock divided by a CMOS cascaded binary divider), a "software UART" can be written to use some I/O pins as serial ports at 110 and 45.45 baud. This, with a Baudot-ASCII-Baudot translation program, implements the basic device.

Many time-sharing services, for example some interactive computer-tutorial and general CAI systems, echo the input character for character and rarely output more than a line or two (e.g., a diagnostic message). If there is enough RAM left, one could implement a few dozen bytes of FIFO space, allowing the device to be used on a 300-baud line in many applications. When the device is designed, one could also leave an unpopulated area on the PC board for later addition of more RAM space.

However, we may still not have enough flexibility to make a product worthwhile. Here are some more suggestions:

There will probably be plenty of I/O lines left to make an X-Y keyboard scan matrix. Now the product can do such things as provide a cheap keyboard implementation for the hundreds of useless 28 RO's lying around.

Finally, with some cooperation with the closed-caption-decoder manufacturers (who would have to put a jack on their device), one could perhaps elicit output on a TV screen.

If you really wanted to get fancy, you could put a Votrax SC-01 and a small speaker in the device and have a limited voice-output repertory. The SC-01's are $100 apiece now but they synthesize phonemically with about 10 bytes/second - not too natural sounding, but intelligible - and you can make your own ROM's.

So, assuming that one can rob low-voltage ac power from the TTY and buy enough µP's to get the price reasonable, it might be possible to build a multi-purpose board (populated and/or jumpered for specific applications) for less than $100 - or about one-fifth the going price of the popular soft-copy terminals. It could be used to add a keyboard to the 28RO, convert a 33 or 35, or be hooked up to a wall-mount transformer and an RS-232 plug to convert an ASCII terminal for TDD network capability.

I'd appreciate any comments.

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THE WD4IWG REPEATER has been nursed back to health by WB4WLW, WB5MMB, a new antenna and new exciter board. Take the time to thank our technical committee for a good job.

PROTOCOL

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NEWS

The ARRL Roanoke Division League Planning Meeting (LPM'81) provided another opportunity to plug packet radio and computer networking. I met some enthusiastic people including John Lindholm, W1XX, the ARRL Communications Manager. John and I had some good discussion concerning the National Traffic System, AMNET and AMSAT Phase III/IV spacecraft. Paul Rinaldo, W4RI and I lobbied for an ARRL technical newsletter for experimenters. I got a much better picture of where AMNET is going. What we have here, I believe, is an amateur radio ARPANET. ARPANET began as a network project which succeeded. It was then used for other purposes. The network itself was perfected and fine tuned in several years of work. I think that AMNET will take a similar path. It begins as experimenters getting together a packet network. In the process, we all learn a lot. After the network works, it will be fine tuned for a while, but mainly it will be used to discuss experimentation in other areas. The teleconferencing aspect will be used to write joint articles for magazines, send drafts to technical editors and receive them back marked up, etc. The network will take the place of the ARRL technical newsletter at that time. I become more excited about this project every day.

Bill Moran, W4MIB successfully transmitted the first AMRAD packet over the club repeater, WD4IWG/R, on May 4, 1981. Unfortunately, there was no one to receive it. My Terminal Node Controller (TNC) board was not working. I discovered why on May 8-9 and then transmitted a packet to W4MIB. More on that later. The project is just off the ground. Next, Terry Fox, WB4JFI will get on the air using the ARRL TNC board which AMRAD is assembling and testing for the League. As additional parts arrive in the mail, boards for W4RI, WB4JFI and Sandy, WB5MMB will be ready to go on the air. I am hoping that we soon will have enough activity to move off the club repeater and onto our own digital store-and-forward node.

Dr. Michael J. Marcus, of the FCC's Office of Science and Technology, spoke briefly at LPM'81. Basically, he stated (again) that if any regulation was hindering our packet work, let him know. He said that the FCC had already granted Special Temporary Authority (briefly) to Doug Lockhart to demonstrate the TNC in a Seattle-to-Vancouver test earlier this year. The authority was required not for the HDLC packets but rather for the lack of a Morse identification. The Canadians do not identify in Morse, only in ASCII in the packet. AMRAD is considering requesting an STA for high-speed (38.4 to 48 kilobaud) synchronous HDLC packets in the near future.

PUBLICATIONS

One of the Canadians has written a book on packet radio. One of the Sterling Park local gang has promised to send me a flyer on it. As soon as I get a copy, I will review it here.

NOTES ON VADCG TNC BOARD CONSTRUCTION

The VADCG TNC board that we are using is documented but not all in one place. W4MIB points out that you must read every jot and tittle of the newsletters coming out of Vancouver, Montreal and Ottawa. My problem with the TNC board was simple. The switch that chooses the speed of transmission for the packets (S2) is incorrectly documented in the information supplied with the board. For 1200 baud (the speed chosen for 2-meter work with Bell 202 modems), switch six (6) should be closed and all others left open. This results in the correct clock speed being sent to the 8273. This information is documented in a newsletter but not with the board documentation.

You must be very careful on which way each IC is inserted on the board. Most all socket positions are marked with a tiny dot on pin one, but watch the picture carefully. Placing a chip in upside down or backwards could have bad results besides just not working. Another small problem, although somewhat documented, is where to place the PROM's. The first Line Interface Program (LIP) PROM, addressed from 0000 hex to 03FF hex, is placed in the U15 socket. The second LIP PROM, addressed from 0400 hex to 07FF hex, is placed in the U16 socket.

The first Terminal Interface Program (TIP) PROM, addressed from 0800 hex to 0BFF hex, is placed in the U17 socket. Thus the PROM's are placed right to left for ascending addresses. The RAM's however are placed left to right for ascending addresses in their sockets. The first 1 kilobyte of RAM, addressed from 0000 hex to 03FF hex, is placed in sockets U19 and U20. The second 1 kilobyte is placed in U21 and U22, etc. Of course the RAM placement is only important if you use less than 4 kilobits of RAM (2 kilobytes will work) or if one is bad and you have a memory test to find the bad RAM.

NOTES ON VADCG TNC BOARD TESTING

Signals that you should find with your scope once you put power on the board are:

•On pin 37 of the 8085 microprocessor you should have clock out. Failure to see clock could mean a bad 8085. W4MIB had this problem. Fortunately, 8085's are inexpensive.

•On pin 25 of the 8273 protocol controller chip you should see divided clock. If you can read the frequency on your scope, you can determine if switch S2 (mentioned earlier) is correctly set and if the 4024 is dividing correctly.

•On pin 29 of the 8273 you should see continuous transitions. These are idles, and if you see a constant high or low there, something is wrong.

•If you have installed the LIPTT and the TIPTT PROM's and the microprocessor is running and stepping through the program, you should see the write line on the 8273 waving in response to the program when you type six characters and control-x on your terminal. It will wave for a while, then go high.

•Pin 35 of the 8273 (Request to Send) should go low on reset. The 1489 level shifter will invert this, resulting in a high on pin 4 of the 25-pin DB25S line output connector. No output from the TNC will occur if Carrier Detect (CD), pin 8 of the DB25S line output connector, is high. That is software working for you (or against you, depending on your viewpoint).

NOTES ON VADCG TNC BOARD OPERATION

You must get Request to Send (RTS) from the TNC board line interface connector to turn on/off your transceiver. In addition, some delay is required for your transceiver to react. If you have a crystal-controlled solid-state-switching rig, reaction time may be very small. If you have a synthesized solid-state-switching rig, reaction time should be on the order of 100 ms. For a relay rig, the reaction time should be about 400 ms (thanks to VE3DVV for this info). This can be dealt with by jumpering your modem for RTS delay (if your modem allows this), or by building a small one-shot multivibrator circuit or by calling me up and getting me to put the delay in the software for you. You can do it yourself if you own a PROM burner. Copies of the software CP/M .ASM files are available from the local gang if you have an 8-inch single-density disk.

NOTES ON VADCG TNC BOARD MODIFICATION

The first modification to make after the board is running and putting out packets is to change the 4024 divider to a 4040 divider allowing 75-baud operation on HF. The rate switch S2 will then switch from 75 to 4800 baud vice the older higher rates. Doing this requires procurement of a 14-pin component header to plug in the 4024 socket and putting a small plastic spacer between it and a new 16-pin IC socket (use glue). Wire the new socket to the component header as follows:

```
4040-10 11 14 12 13 04 08 -- 02 -- 03 05 -- 16
4024-01 02 03 04 05 06 07 08 09 10 11 12 13 14
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Thus, we are substituting a twelve-stage divider (4040) for a seven-stage divider (4024). W4MIB has tested this change and reports success.

The next modification required is some sort of conditioning for the reset line and the trap line. Both are ragged and do not work well. The Hamilton gang reports that using the trap line as supplied results in lost registers from the line bounce. They supplied a circuit which W4MIB is testing, and a report will appear here next month on how it worked, along with the details.

Another modification is a status LED tied to the 8085 SIO line. This LED blinks to indicate TIP initialization, station connect, LIP initialization, etc. It looks worth trying. I will install it and give a complete report next month.

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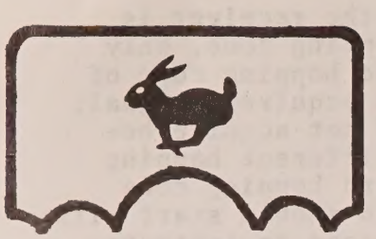
8273 PROTOCOL CHIPS are available from Bill Moran, W4MIB, 109 Mill St NW, Vienna, VA 22180 for $35 each. Telephone 703-938-6924.

TRANSTERM 1 is a small, portable ASCII terminal being offered by Computerwise, Inc, 4006 East 137th Terr, Grandview, MO 64030, 816-765-3330. It includes a 53-key keyboard and a two-line 64-character liquid crystal display housed in a 2 x 12 x 7-in case. It provides full-duplex RS-232 serial communication as well as 20-mA and RS-422 options. Data rates are 300, 1200, 2400 and 9600 baud. Unit cost is $449.00.

WIREMASTER is a program to aid layout of p-c boards, available from Afterthought Engineering, 7266 Courtney Dr, San Diego, CA 92111, 714-279-2868. It runs on Z80 and TRS-80 Model1 II CP/M systems of 48 kilobytes or larger. Diskette and manual $150; manual only $4.



SPREAD SPECTRUM

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USING MICROPROCESSOR-CONTROLLED RIGS FOR FREQUENCY HOPPING

A number of people have expressed interest in the idea of using microprocessor-controlled ham rigs as the basis of a spread spectrum frequency hopper. The idea is both interesting and appealing. In this article some of the requirements for such a setup will be examined.

First, let's take a closer look at what a frequency hopper does. The frequency hopper may employ standard modulation such as single sideband (SSB) in the primary information path. Other types of modulation are okay but may not provide the same level of noninterference to other users. Care must be taken to avoid creating another Russian woodpecker. The Russian woodpecker is an over-the-horizon radar which emits a train of short pulses. These pulses are very wideband and bother a large number of users.

Modulation techniques such as CW, AM or FM all have the capability to be a woodpecker if care is not taken. In this respect, SSB has advantages such as no carrier and an average amplitude of much less than maximum.

Some ham rigs get very sensitive about being mistuned. This may not be a great problem with some rigs that are either broadbanded or autotuned. Some antenna systems have very similar problems in that they must be peaked before you start operating. Of course, all this depends on the power you are running, sensitivity of your equipment and the limits of hopping frequencies.

In the AMRAD Special Temporary Authority (STA), the FCC allowed us to experiment with frequency hopping only within the U.S. amateur bands on a non-interference basis. Specifically, we are permitted to use 80, 40, 20 and 10 meters for frequency hopping tests. Ten meters seems prime for experiments because there is more room than in the lower-frequency bands.

Another thing that should be kept in mind is the so-called near/far effect. When you are operating a spread spectrum station, a receiver at a moderate distance should not hear anything unusual. The signal strength at this particular receiver will be low, and only a short piece of the signal can be heard every now and then. But suppose that the receiver was loaded into a vehicle and was driven in your direction. What would be the result? The signal strength of the spread spectrum signal would rise as the receiver approaches the QTH. When the receiver is very close it will receive a very strong pulse every so often and probably cause the automatic gain control (AGC) to reduce the receiver's gain. There could also be some desensing of the front end due to overload. (Note that the exact action of the near/far effect will vary according to the specific type of spread spectrum modulation used.) Your spread spectrum signal would hardly be invisible to that receiver. But the receiver's operator might not be able to tell what it is. If you cause television interference (TVI), the TV set owner will unlikely know the source of the interference. Some hams say that SSB is better for TVI because "they" can't tell who it is. With AM modulation, your voice might come clearly through the TV set. In any event, TVI is no blessing even if the victim can't tell who's talking.

What about all this invisibility stuff? It is true that normal receivers won't be bothered by your signal if you do it right. That means that your hopping pattern must appear to be very random and that the speed of hopping should be less than about 1/5th of a second. This is considered a minimum for invisibility and yet presents a problem for some standard synthesizers. There are two ways of generating a frequency for a frequency hopper. Both involve the synthesizer approach to life. The first uses a phase locked loop or PLL. In this approach, the local PLL oscillator is driven by an error voltage. The error voltage is produced by dividing down the VCO oscillator frequency and comparing that with a standard reference oscillator. By doing the VCO division right, the error voltage will trick the VCO into oscillating on a different frequency. The frequency in this case will be set by the divider circuit within the PLL. The divider is what you control from the

frequency knob of the rig.

If your rig uses a synthesizer, you should investigate and verify that the time it takes the synthesizer to lock onto a given frequency is much less than 200 ms. For the hopping rate of 5 hops/s (or chips) your synthsizer must lock up much faster than this. Still, many say that 10 hops/s is the smallest that you should use, but this requires even faster synthesizer lock-up time.

How can you determine the lock-up speed? Many synthesizers have a transmit inhibit lead which is used to kill the transmitter when the rig is moved in frequency. This is required so that the VCO doesn't cause the transmitter to operate outside the band or put out a signal on an undesired frequency. The exact setup on your rig must be investigated. You can get a ball-park idea by just rotating up a bunch of frequencies and checking how much time is spent in an unlocked condition. Many synthesizers cannot be used because of the slow locking speed. CB sets, for example, usually don't do well in this respect.

Preamble and synch are the next things to think about. Let's take synch first. Synchronization is the process by which your rig and the other station's rig stay at the exactly right place in your hopping code pattern. If you or the other station fall out of synch no signal will be acquired. This means that some way is needed to keep the hopping code generators in the two rigs together. How can this be done? It can be difficult. The military approach is to use very expensive timing sources. An amateur approach, which has yet to be tried out, is to use the rise and fall of the signal (as the hopper switches frequencies) as a correction signal. You must have a timing source at your station and at the station that you are talking to. Because the timing source will be used to trigger a hop at your station, both stations must be synched. If you see that the other station's signal falls and you have not hopped then you can assume that your timing is a little slow. You can speed it up a little or slow it down depending on what is happening.

This is the first place that a microprocessor may be useful. The synch algorithm and clocking (using real-time interrupt facility) could be controlled in a very intricate manner with software. Some people expect that synch problems will stand in our way. Will it?

For two frequency hoppers to start a contact, they need a method that lets the other know that one has fired up. This may be done with a preamble. A preamble is simply a signal which the transmitter sends to alert the receiver to start hopping. The preamble can be a simple set hopping pattern which everyone uses. If this were used, every receiver would hear the preamble and make ready to hop. When the receiver is switched to its normal hopping code, only the receiver with the same hopping code of the calling station would acquire a signal. The other receivers would not acquire because they are set to a different hopping code. Perhaps the standard hopping code which follows the preamble should start with a few tenths of a second tone to indicate that the receiver is now locked. A receiver which did not acquire a tone after the preamble would resynch to the preamble and wait for the next calling station.

There are some procedural problems that need to be dealt with, such as how two stations should act if they lose on another. Should they automatically retransmit the preamble? Should they go to some prearranged place in the hopping code and try again to achieve synch? These questions are open, and solutions are welcome.

The three areas mentioned above (synch processing, preamble processing and handling fadeouts) all require complex decision making in real time. This is a place where microprocessors can be used with good effect.

Coding of the frequency hopper is something that interests people. There are several possibilities here for different codes, but some form of standardization is needed. Without standardization, only a limited number of hams could communicate with each other. Remember that each code sequence is a new "channel."

AMRAD has decided to use the popular Gold codes for controlling the hopping pattern. Gold codes are easily generated and provide for a large number of possible channels to be generated.

There are two popular schemes for hopping, and both depend on the following idea. If you have several stations hopping around in (say) the 40-meter band, you would like to avoid hopping to the other station's frequency if you are trying to talk to someone else. In other words, you don't want to use a frequency in your hopping pattern if someone else has hopped there. How can you control this? The hopping codes (called PN codes) are designed to avoid collisions by using only those codes which have a small amount of collisions to start with. The Gold codes are one of these. M-length are another. Both codes are generated with linear feedback shift register circuits which can be loaded by the microprocessor. See CMOS Cookbook or TTL Cookbook for details.

Well, in this informal article we have explored some of the requirements of spread spectrum using microprocessor-controlled rigs. As you can see, many of the processes are complex and best implemented in software, with the exception of a shift register for code generation. Please let me know your comments. □

Radio Amateur Technical Achievements

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Radio amateurs have been called "appliance operators." Also, Federal Communications Commission (FCC) Commissioner Ferris has been quoted as saying that hams and citizens band operators (CBers) are the same except for what they talk about on the air. Of course, there is some truth to both of these things. On the contrary, there is nothing to apologize for amateurs operating for many hours either for public service or just the plain fun of ragchewing. Implicit in these comments on hams is that many do not build their own radio equipment but buy it off the shelf and send it back to the factory when it needs to be repaired. again, no apologies. Commercially manufactured equipment has long been a part of amateur radio. The reasons are manifold: lack of time to homebrew everything, the good performance of commerical equipment, reasonable cost of the manufactured item compared to higher cost of the components purchased separately, etc.

That's only part of the story. The other side is that radio amateurs have made a strong and continuous contribution to technology starting with the early days of radio. It may not be apparent to those who are out of contact with this aspect of ham radio that there is more experimentation and homebrewing now than ever before. Take a look at the number of technical articles published in the U.S. amateur radio publications *QST, Ham Radio, 73, CQ, Orbit, A5, RTTY Journal* and the *AMRAD Newsletter*. In addition, radio amateurs have been heavily involved in the microcomputer revolution since about 1975. They are also writing articles for computer magazines such as *Byte, Microcomputing, Interface Age, Amateur Computer Group of New Jersey News, Hom Computer Club Newsletter,* and *San Diego Computer Society Personal Systems*. Because their call signs do not necessarily appear in their computer magazine articles, the fact that they are hams can go unnoticed.

It may be a small point, but the term "radio amateur" is used throughout this paper instead of "amateur radio operator." "Radio amateur" describes all of us, not just those who *operate*. The point is that there are a number of radio amateurs who design and build equipment. They may operate their equipment only briefly to see that it works, then put it on the shelf to gather dust. Their fun is in the creation, not the operating.

It is unfortunate that many experimenters do not document their work. So the articles in amateur journals do not cover all the experimental work. In addition to not writing, they often avoid giving talks on their projects. It is downright difficult to drag the information out of some experimenters except on a one-on-one basis in the experimenter's shack. It would be useful for hams with writing capabilities to team up with experimenters in order to document some of this work.

Some experimenters who can and do write are discouraged by the long editorial lead times of the amateur radio magazines -- typically three months to 18 months before the author sees his article in print. This means that a truly state-of-the-art experimental article will be obsolete by the time that it is read. This is frustrating and embarassing to the experimenter. The article will be of no use to other experimenters in the same field because they may have gone beyond the point where the article will help. Word-of-mouth communication is much faster, and when it happens at the right time there is a flywheel effect. However, this type of communication is very selective and leaves out of the process other people who might contribute in some way. Clearly, a faster way is needed to exchange experimental data. It is likely that computers will be used to provide experimental data banks for amateur experimentation. For the moment, however, another solution is called for.

I would like to see the ARRL Board of Directors approve the creation of a League newsletter for experimenters. I first suggested this in a letter to the Long Range Planning Committee. The idea was circulated at ARRL Hq and was given the working title of *Experimenters' Exchange*. The plot is for the League to publish a technical newsletter carrying timely technical material. It would have a very short editorial lead time on the order of a month. In exchange for this speed, some of the articles would lack the polish and verification of accuracy that you are accustomed to in *QST*. The whole point is that this new publication may help to get some of the current experimenters out

of the closet. A new ARRL publication of this sort needs your support. Let your Division Director know that you're interested in seeing it happen.

Because many radio amateurs have jobs in electronics, it is sometimes hard to tell the professional from the avocational activities. Often the two complement each other. In a general sense, individuals do what they are paid to do on the job. Once home in the shack, the ham can ordinarily do what he pleases. Sometimes, it's a matter of doing things at home that "they said couldn't be done" at the office. A ham experimenter prides himself on making something simpler and cheaper than a commercial effort. Furthermore, he can satisfy himself that it is done *right* rather than whatever was imposed on him at work. The fruits of his labors in the hamshack have been applied in various ways to countless projects in the workplace. The results are that hams have contributed toward starting new ventures, simplifying processes, and reducing the cost of equipment.

Here is a sampling of radio amateur technical achievements over the years:

•In the early days of wireless, scientists and engineers believed that short waves were suitable for only short-distance communications. Short waves were considered so useless that all frequencies above 3 MHz at one time were available for use by hams. Amateur experimenters discovered that short waves propagated long distances. Their work went into the eventual understanding of the ionospheric propagation mechanism and the use of short waves by many radio services.

•Amateurs were experimenting with television using scanning disks in the late 1920's. They were experimenting with electronic TV in 1937.

•Also in the 1930's, a number of radio amateurs including Stu Meyer, W2GHK were engaged in making two-way radios practical for police communications.

•In the late 1930's, Grote Reber, W9GFZ built the first radiotelescope. He also discovered solar noise and made the first noise map of the sky.

•The World War II years 1941 through 1947 saw many hams in military service. Radio amateurs were sprinkled throughout the Army and the Navy. The U.S. Army Signal Corps and the Office of Stategic Services, in particular, made effective use of hams. Those not pressed into military service were involved in building equipment for the military. Bill Halligan, founder of Hallicrafters, was busily engaged turning out BC-610 (HT-4) transmitters which were a mainstay for both the Army and hams after the war. Art Collins produced much of the airborne radios including the ubiquitous command radios.

•After World War II, hams returned to their shacks and started experimenting with some new concepts. Amateur single sideband (SSB) was born in September, 1947 when O.G. Villard, W6QYT using the call W6YX made SSB contact on 75 meters with W6VQD. This marked the first practical SSB operation leading to today's SSB. However, it was not the first. That honor goes to Art Nichols, WØTQK who was experimenting with SSB in 1933. Later, in the 1950's, two hams, Generals LeMay and Griswold introduced some of Art Collins' ham SSB equipment to the Strategic Air Command. They showed that the SSB radios could be used to communicate from an aircraft anywhere in the world to SAC Headquarters in Omaha.

•Also just after World War II, hams went back to experimenting with television, this time with the new 525-line commercial standards. I recall that in 1950 when I was W9IZA I constructed a complete 420-MHz amateur television (ATV) station which used a flying-spot scanner and sync stolen from a commercial TV station. The design was mostly that of J.R. Popkin-Clurman, W2LNP who published an article in *Radio & Television News* starting with their May 1950 issue.

•In the late 1040's, Clarence Moore, W9LZX designed the quad antenna. I understand that he also founded Crown Electronics who makes tape recorders. Another antenna clearly identified with a ham is the end-fire driven array known as the W8JK or 8JK. But that's not all. It seems that hams have been obsessed with antennas and involved in the development of nearly all types.

•World War II produced a surplus of teletypewriters. Radioteletype (RTTY) operation got its real start on two meters on both the east and west coasts of the U.S. Audio-frequency-shift-keying (AFSK) of AM transmitters was the thing then. F1 FSK was not permitted on the HF bands until February of 1953. One of the pioneers of amateur RTTY was Robert Weitbrecht, W6NRM (for a while W9TCJ) who is deaf. Bob went on to develop an AFSK teletypewriter system for use on the telephone lines by the deaf. There are now approximately 75,000 TTY machines in use by the deaf.

•In the 1950's, Copthorne Macdonald, WØORX (now VE1BFL) ran extensive on-the-air experiments with slow-scan TV (SSTV). The only HF band on which these tests could be made at the time was 11 meters. When that was lost, limited tests were permitted in the 10-meter band. Eventually the FCC allocated frequency space for SSTV in 1968.

•Throughout the 1950's, hams were experimenting with VHF radio. Newer low-noise front ends for receivers, higher power and more directive antennas led to the discovery of new propagational modes including the Transequatorial Propagation or TE Mode. See *QST*, December 1959.

•In December 1961, OSCAR 1 was launched into space. It was the first non-governmental satellite ever launched. It was built in basements and garaged by hams under the banner of the Project OSCAR Association. OSCAR 1 transmitted the Morse characters HI HI for three weeks at a power level of 100 mW before its battery gave out. It was followed by OSCAR 2 which was launched in June, 1962. Like OSCAR 1, OSCAR 2 made simple telemetry transmissions.

•OSCAR 3 was launched in March, 1965. It was the first free-access communications satellite and the first satellite through which amateurs could send signals. Both input and output operated in the 2-meter band. OSCAR 4, launched in December, 1965 was short lived because it did not reach its planned orbit. It received 2-meter signals and transmitted on 70-cm.

•In 1969, the Radio Amateur Satellite Corporation (AMSAT) was formed in Washington, DC. AMSAT coordinated an international effort in cooperation with University of Melbourne, Austraila students to build OSCAR 5. It was launched in January, 1970. This satellite transmitted signals in the 2- and 10-meter bands.

•OSCAR 6 was launched in October, 1972 and functioned well into its fifth year, far longer than its one-year design life. This satellite was used for a number of experiments including the first interlinking of satellites.

•OSCAR 7 was developed by amateur groups in the United States, Canada, West Germany and Japan. It was launced into space in November, 1974. OSCAR 8 was a similar international effort which was sent into orbit in March 1978. Construction costs for this satellite were paid for by the ARRL who has operational responsibility for it.

•May 23, 1980 was supposed to be the successful launch date for the AMSAT Phase IIIA satellite but turned out to be *Black Friday*. This was due to the failure of the Ariane launch vehicle. The AMSAT gang fortunately found the talent and energy to start building Phase IIIB for a launch in 1982. Phase IIIB will be placed in a highly eliptical (Molniya-type) orbit which will make it available to most of the amateur population of the world for many hours each day.

•Leaving satellites, in 1973 a new group formed in the Washington, DC area with the purpose of establishing the world's first ATV repeater. That group was known as Metrovision. Their repeater was operational in 1974 and is still going. Since then, a number of other groups have set up similar ATV repeaters throughout the U.S. Much of the ATV repeater pioneering was done by Bruce Brown, W9GVK and the current AMRAD Vice President, Terry Fox, WB4JFI.

•Throughout the 1970's and into the 1980's, hams have been experimenting with coherent CW (CCW). By employing narrow bandwidths, precision frequency accuracy and time synchronization, gains of around 20 dB over conventional CW can be realized.

•It is difficult to pin down when hams started experimenting with microcomputers. Probably 1973 was the start of today's activity. It was not until 1975 that microcomputer equipment became widely available with the advent of the MITS Altair kit. Many radio amateurs were involved in the development of microcomputer systems, both for fun and profit. For example, Robert Suding, WØLMD designed the Digital Group computers. Two hams, Ward Christensen and Randy Suess came up with the first Computerized Bulletin Board System (CBBS) -- computer hobbyists can access about 200 of these systems via telephone line. Bob Bruninga, WB4APR was the first to develop a bilingual CBBS, one that spoke Baudot over the air and ASCII via the telephone lines. That system has now evolved into a bilingual telephone line system for the deaf, called HEX.

•Most of the early amateur radio computer activity was conducted on the air with Baudot because ASCII had not been legalized. All of that changed not too long ago. In Canada, the Department of Communications created a new Amateur Digital Radio Operator's Certificate and issued new rules for packet radio in 1978. This gave the Canadian hams a head start. ASCII operations in the U.S. had to wait until the FCC authorized this code as of March 17, 1980. On that historic day, 18 AMRAD members were ready to go at the stroke of midnight. Fourteen stations made successful two-way ASCII contacts on the AMRAD 81/21 machine. Since then, in addition to packet pioneering in Canada, Hank Magnuski, KA6M came on the air with the first U.S. packet repeater in the San Francisco, CA area. He has since been joined by about eight stations in his area. Using protocol boards developed by VE7APU, five AMRAD members in Northern Virginia are about ready to go on the air with packets. AMRAD has also constructed one of these boards for W1AW.

•Spread spectrum was an absolutely unthinkable mode for amateur radio -- until now. In March, 1980, the FCC issued an STA to 26 AMRAD members to experiment with this mode. The first successful spread spectrum tests were made on May 5, 1980 during two-way contact between Dick Kessler, K2SZE in Rochester, NY and Paul Rinaldo, W4RI, in McLean, VA.

The above technical achievements by radio amateurs are in effect the tip of the iceberg. It is just the barest outline to be completed by others doing more scholarly research. The whole story would fill a book.

In conclusion, I would like to make the

following points:

•Amateur radio experimenters have made many important contributions to electronic technology.

•There is more experimentation today than ever before.

•In the past there has been a delay between the time when amateurs are ready to use a new technique and when it is accepted by the ARRL and FCC. I'm happy to say that both institutions are squarely behind experimentation. Members and League officials should do what they can to support this positive and enlightened attitude.

•Experimenters need a better way of getting the news to each other. I have suggested creation of a new ARRL newsletter for this purpose. Eventually, we'll need a computerized data base for experimenters.

•Some of this new technology is going to cost money. AMSAT's Phase-III satellites will cost hundreds of thousands of dollars. setting up an amateur computer packet network with hundreds of switching nodes will be on the same order. The League can help with the funding of these large projects.

In closing, I would like to acknowledge the inputs made by Bob Haviland, W4MB, Bill Tynan, W3XO, Jose Kasser, G3ZCZ and AMSAT.

FOR SALE:
TMC QRP transmitter, 100 mW, Transmitting Mode Selector Model 3BE2/Exciter Unit Model A-1516, Portable Master Oscillator Model PMO2, Power Supply Model A-1397, SSB, ISB, CW, FSK, FAX, 2-32 MHz, 3 pcs, $150 w/manual.

FSK Oscillator, Tone Intelligence System for use with QRP TX system, Model TIS 3m, w/manual, $25.

Remote controlled antenna matching system for parallel open-wire line feeders, designed for dipoles, Model HFAS-1, 2 pcs, w/ manual, $75.

Millen 90921 scope amp & rack, 2 pcs $30.

Radio receiver, R-392/URR w/manual, $200.

CD Rotator AR type w/indicating controller, $30.

Nems Clark solid-state receiver, Type R1037F-15, containing plug-in RF tuner 135-155 MHz, Type RFT-100A, $20.

TMC Tone Intelligence System, Model TIS 3, $15.

Radio transmitter w/power supply, 4-26 MHz, Two 4-125A tubes, 2 pcs $175.

Lambda regulated power supply Model 50, 800-watt, 0-500-volt, $25.

Command set receiver, 190-500 kHz, $15.

Tube tester, TV-3C/U, w/schematic, $30.

Frequency meter FR-67/U, w/manual, $30.

Two outlet strips of 6 outlets, ungrounded, $10 each.

Multi Elmac w/power supply, Model AF67, AM/NBFM/CW, 80-10m, W/book, $50.

Conrac video monitor w/manual, $150.

Two Eimac 4-400A tubes, $75 pr.

Model 35 ASR $250.

Model 35 ASR $200.

Two Model 28 typing reperfs, $25 each.

Model 28 RO,printer, $50.

Double 28 TD, Triple case, $15.

Triple M28 TD, $25.

Two triple M28 TD's, $50 each.

M35 typing reperf, keyboard, $100.

Torn-tape system, two cabinets, mint condition, unassembled, w/schematics and manuals, $1500.

Model 28 ASR, 100-wpm, 7-unit code, $250.

XT-4 shifter, w/two panels including dedicated receiver/transmitting osc., digital clock, owc (XTL) for MARS freqs (RTTY) 4020, 4025, 4030, 4035 plus some 3-MHz, printed data also available, $125.

Eight XT-4 p-c boards, $2.10 each.

UT-4 w/TX/RX speed converter, $125.

Hewlett Packard 5282A, 225-MHz counter w/book, $250.

Premax #SS1135, stainless-steel telescoping vertical antenna, 6 sections, 6 ft 4 in, extended 35 ft 7 in, w/base, $125.

Kleinschmidt Typing Reperforator, Model TT-107B/FG, $35.

Two TD's, Triple TD's, stand alone, sync motor, $50.

Sixteen typing reperfs only, $12.

Three 6-ft racks, $7.50 each.

Telephone: 703-256-0716.

FOR SALE:
Intel Multibus components with documentation:

1 - SBC80/20-4 single-board computer
1 - National 16KB memory board
1 - 4-slot terminated mother board

Matrix printer, Practical Automation Model DMTP-6 5x7 dot matrix, 80 or 132 columns/line, 8.5 inch wide paper, fanfold or roll paper, has friction feed. Complete documentation. Comes with power supply and homemade cabinet. $150.

KSR33 TTY in good condition, 20-mA current loop, with documentation, $175.

Steve Stolen, 703-360-3470 (eves).

FOR SALE: Vadic modem cards, originate only, Bell 103, full-duplex, with WB4APR documentation, $25. Terry Fox, 703-356-8334 (eves), or leave a message on the AMRAD CBBS, 703-734-1387.

RADIO SYSTEMS ENGINEERS are being sought for a large utility in New York City by John Hart of Robert Heller Associates Corp of Greenwich CT, 203-869-1666. This position is in the $30,000 to $45,000 range. They are also looking for Telephone Communications Engineers ($30,000 to $40,000) and a Senior Telephone Communications Engineer ($35,000 to $45,000). Call or write c/o 25 Valley Dr, Greenwich, CT 06830.

THE AMRAD NEWSLETTER PAYS for articles which have not appeared elsewhere at a rate of $10/page (less for partial pages), $20 maximum per issue. We need articles on interfacing specific computers to ham equipment.

THE DEAF AND THE TTY

Barry Strassler
Executive Director
Telecommunications for the Deaf, Inc.
814 Thayer Avenue
Silver Spring, Maryland 20910
301-589-3006

CALIFORNIA DUAL MODEM ILLUSION?

In this column of the March 1981 issue of the *AMRAD Newsletter*, it was joyously announced that California Public Utility Commission required a dual ASCII-Baudot modem as the TDD to be given free to all deaf Californians. Seems that the joy was shortlived. All rulings either have loopholes or overlooked fineprint wording. In the case of the California ruling, it was discovered that the manufacturers can invoke the cost-effectiveness clause as a way out of the ASCII requirement.

It works this way -- if an XYZ Baudot TDD costs $300 to manufacture, and if that XYZ company determines that it would cost $350 to manufacture a dual ASCII-Baudot modem, then they are not bound legally by this ruling.

TDI has been asking, "Do we really need an ASCII modem?" There are 75,000 Baudot modems in the United States. And a great majority of deaf TDD users have never heard of ASCII much less care to learn what it is all about. In addition, there are great numbers of low-income deaf households, struggling to make ends meet and lacking discretionary income for such "luxuries" as a TDD or a Sears captioned decoder.

The ASCII modem in its *present* form poses protocol problems in deaf communications. In a deaf household with a Baudot modem, when a light flashes on indicating a telephone ringing, determining the call to be voice or TDD is simple. The deaf person would first place the handset in the modem cradle and then wait for the TDD message to be shown. If there is none, it is assumed to be a voice call. But let us assume that ASCII capability is added to the modem. Then a telephone rings leaving a deaf person with three choices - ASCII, Baudot and voice. Whether this sort of protocol is easily handled remains to be seen. I have an Apple II at home with a Hayes modem. Steve Brenner, a friend of mine who is also an AMRAD member, also has an Apple and a Hayes modem. We both have fooled around with ASCII-only protocols and have not been satisfied with what we could do.

And again, some so-called ASCII capabilities in a TDD modem may be illusory. If the ASCII capability is not predicated on Bell 103 standards but on the present TDD modem standards, then this ASCII "progress" is actually non-progress.

Ed. Note: Nan and Sandy Sanders have come up with a Baudot interface for the Apple, using the game port and an external TDD modem. When the phone rings, the phone handset needs to be placed in the TDD modem cups. Bell 103 ASCII calls can be auto-answered using the Hayes modem. An alternative setup is to use the new Novation Apple-Cat II which can auto-answer TDD and Bell 103 calls (plus Bell 202 1200-baud calls). If you have any thoughts on how to auto-answer and determine what type of call it is (including voice), please pass them to Sandy, WB5MMB, 703-281-1298 voice or Nan Sanders, 703-281-9390 TDD.

AMRAD **Amateur Radio Research and Development Corporation**

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THE AMATEUR RADIO RESEARCH AND DEVELOPMENT CORPORATION is a technically oriented club of about 400 radio and computer amateurs. It is incorporated in the Commonwealth of Virginia and is recognized by the Internal Revenue Service as a tax-exempt scientific and educational organization.

THE PURPOSES OF THE CLUB are to: develop skills and knowledge in radio and electronic technology; advocate design of experimental equipment and techniques; promote basic and applied research; organize forums and technical symposiums; collect and disseminate technical information; and, provide experimental repeaters.

MEETINGS ARE ON 1st MONDAY of each month at 7:30 p.m. at the Patrick Henry Branch Library, 101 Maple Ave E, Vienna, VA. If the 1st Monday is a holiday, an alternate date will be announced in the *AMRAD Newsletter*. Except for the annual meeting in December, meetings are normally reserved for technical talks - not business.

THE WD4IWG/R REPEATER is an open repeater for data communications (including RTTY), voice and experimental modes. It is located at Tyson's Corner, McLean, VA and has excellent coverage. It features a semi-private autopatch available to licensed members. Frequencies are: 147.81 MHz input, 147.21 MHz output. The head of the technical committee is Jeff Brennan, WB4WLW, 7817 Bristow Dr, Annandale, VA 22003, phone 703-354-8541.

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THE AMRAD MESSAGE SYSTEM is an S-100 Computerized Bulletin Board System on 703-734-1387, system operator Terry Fox, WB4JFI. Terry's home phone number is 703-356-8334. The system accepts 110, 300, 450 and 600 baud ASCII callers using Bell 103-compatible modems.

THE HANDICAPPED EDUCATION EXCHANGE (HEX) is operated by AMRAD for those involved in education and communications for the handicapped. It accepts both 110/300-baud ASCII and deaf TTY callers. on 301-593-7033. The sysop Dick Barth, W3HWN's home phone is 301-681-7372.

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SPECIAL INTEREST GROUPS are formed from time to time. Currently we have SIG's on Deaf Communications and Spread Spectrum Communications. If you are interested in joining or forming a SIG, please contact Bill Pala, WB4NFB, 5829 Parakeet Dr, Burke, VA 22015; phone 703-323-8345.

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